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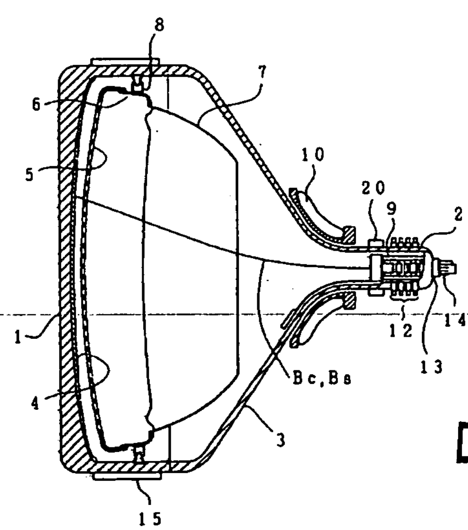
(54) Inline type color picture tube

(57) A color picture tube featured in that a panel (1) is substantially flat on its outer surface, an inner surface of the panel is curved, a shadow mask (5) has a curved plane having its curvature that is further greater than the curved plane on the inner panel surface, the panel is made of glass such as a tint material, a ring-like magnet assembly (12) (PCM) for convergence adjustment is provided outside of the neck (2), a first electromagnetic quadrupole coil (20) is further attached to a portion outside of the neck (2) for causing an electron beam spacing to change or vary in accordance with a deflection angle, a second electromagnetic quadrupole coil is attached to a deflection yoke, and the distance between adjacent ones of three cathodes of an electron gun is determined to be greater than or equal to 6.0 millimeters (mm).

FIG. 1



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Description

Background of the Invention

[0001] As demands for further enhancement of image recognizabilities on a display screen are becoming more strict along with a growing need to reduce external light reflectivity thereon for prevention of unwanted on-screen visualization of "ghost" images of exterior scenes, color picture tubes with a panel made flat on its outer surface have been developed in recent years. One prior known approach to achieving this is to let the panel have certain curvature on its inner surface while making the panel's outer face flat. This methodology is capable of causing a shadow mask to exhibit a curved plane, which in turn make it possible to take full advantage from currently available shadow-mask manufacturing architectures. On the contrary, the prior art approach suffers from existence of a necessity of specifically designing the panel in such a way as to have an excessively large curvature relative to the inner panel face as compared to that on the outer face thereof, which would result in an excessive increase in glass plate thickness at or near the periphery of the panel when compared to the glass thickness at the center thereof. This disadvantageously serves to pose a serious problem which follows: Possible differences in brightness or luminance between certain locations, one of which is the center of a phosphor film and the other of which is the periphery of the phosphor plane, along with influence or interference of the curved plane on the inner panel face can deteriorate or degrade the flatness of display screen as felt by users. Accordingly, in the event that the outer panel face is made flat, it is recommendable that the curvature of the inner panel face be as less in value as possible. On the other hand, the manufacturability increases when the shadow mask remains larger in curvature. A traditionally proposed way of solving this is that the between-electron-beams distance S-size is designed so that it is made smaller at the periphery of display screen than at the center thereof. This technique has been disclosed, for example, in a report of the International Display Workshop (IDW) '98 at pp. 412-416. This document discloses therein the principle of a technique for reducing the net value of the S-size at the periphery by employing a couple of electromagnetic quadrupoles. Unfortunately the advantage of this approach as taught thereby does not come without accompanying various problems which follows: Those images as visually displayed on the screen are less in contrast; additional panel-surface processing should be required inevitably; and, geomagnetism influence stays greater due to the fact that the resulting distance between the inner panel face and its associative shadow mask, i.e. q-size, remains greater at the periphery.

Summary of the Invention

[0002] The present invention is the one that enables achievement of a color picture tube including a panel section with an outer surface made substantially flat and having required contrast and geomagnetic margins or the like without requiring effectuation of panel-surface processing even in cases where a press formed shadow mask is used. To attain this, the present invention as disclosed herein is such that tint or dark tint materials are employed as a glass material for use as the panel while at the same time specifically setting a difference between a glass plate thickness, Tc, at the center of such glass and a glass thickness, Td, at the periphery thereof namely, a ratio Wd/Tc of the so-called "wedge amount" Wd to the value Tc—to be less than or equal to 0.8 or alternatively letting the absolute value of Wd be set at 12 millimeters (mm) or less. Further, letting the S-size at the cathodes of an electron gun be set at 6.0 mm or below makes it possible to suppress or minimize any possible influence or interference of the geomagnetism at the periphery of a display screen concerned. While two pairs of electromagnetic quadrupole coils are used to render the net value of such S-size smaller at the screen periphery than in the center thereof, the first one of such electromagnetic quadrupole coils is provided overlying a neck portion of the picture tube along with more than one ring-shaped purity/convergence magnet (PCM) operatively associated therewith.

Brief Description of the Drawings

[0003] Fig. 1 is a schematic diagram of a color picture tube in accordance with the present invention. Fig. 2 is a detailed diagram of a panel. Fig. 3 is a diagram for explanation of a scheme for permitting an S-size to change or vary effectively. Fig. 4 is a first layout explanation diagram of a first electromagnetic quadrupole coil module. Fig. 5 is an operation/effect explanation diagram of the first electromagnetic quadrupole coil in the case of using a pole piece. Fig. 6 is a second layout explanation diagram of the first electromagnetic quadrupole coil unit. Fig. 7 is an example of an electron gun used in the present invention. Fig. 8 shows one example of a main lens used.

Description of the Preferred Embodiment

[0004] Fig. 1 is a schematical diagram of the present invention. In Fig. 1; reference numeral 1 designates a panel portion; numeral 2 a neck portion; numeral 3 a funnel portion; numeral 4 a phosphor film; numeral 5 a shadow mask;

numeral 6 a mask frame; numeral 8 mask support mechanism; numeral 7 an inner magnetic shield; numeral 10 a deflection yoke; numeral 9 an electron gun; numeral 12 purity and convergence correction magnet (PCM); numeral 13 stem pins; numeral 14 a stem; numeral 15 a protection band; numeral 20 a electromagnetic quadruple coil; and Bc center electron beam; Bs side electron beams. In the cathode ray tube shown in Fig. 1, an evacuated envelop is constructed of the panel portion 1, the neck portion 2 housing the electron gun, and the funnel portion 3 connecting the panel grass portion and the neck portion.
The shadow mask 5 is welded to the mask frame 6 and is suspended by the support mechanism 8 with the support pins which are buried in the inner wall of the skirt portion of the panel portion 1, so that it is held at a predetermined spacing from the phosphor film 4 formed on the inner face of the panel portion.

[0005] A panel 1 has its outer surface that is flat or alternatively has an extremely large radius of curvature. Generally the curved plane of such panel is obtained in a way such that when letting a drop-down amount from the panel center be represented by "Z," which is given as

$$Z=A1X^2+A2X^4+A3Y^2+A4X^2Y^2+A5X^4Y^2+A6Y^4+A7X^2Y^4+A8X^4Y^4,$$

then determine those coefficients or parameters A1 through A8 in the equation above. Some examples of the panel's curved plane in case the present invention is applied to a 36V-type color picture tube (CPT) are shown in Tables 1 and 2 below.

Table 1.

Parameters A1 - A8 of the outer panel surface:			
A1	0.1156035×10^{-4}	A5	$-0.1309278 \times 10^{-19}$
A2	$0.1545012 \times 10^{-14}$	A6	$0.9600291 \times 10^{-14}$
A3	0.2125280×10^{-4}	A7	$-0.3875353 \times 10^{-19}$
A4	$-0.2866930 \times 10^{-10}$	A8	$0.4856608 \times 10^{-25}$

Table 2.

Parameters A1 - A8 of the inner panel surface:			
A1	0.3839236×10^{-4}	A5	$-0.5680002 \times 10^{-17}$
A2	$0.5662136 \times 10^{-13}$	A6	$0.3385039 \times 10^{-11}$
A3	0.1499420×10^{-3}	A7	$-0.2802914 \times 10^{-16}$
A4	$-0.4172959 \times 10^{-9}$	A8	$0.6708166 \times 10^{-22}$

[0006] In the panel discussed above, the radius of curvature is generally different in value depending upon locations. For evaluation of the flatness of such panel, it will be able to use an equivalent radius of curvature due to the dropdown amount in a diagonal direction as shown in Fig. 2. In this case, when letting a half of the effective diameter in such diagonal direction be represented by "Dd" while letting the dropdown amount be indicated by "Zd" as shown in Fig. 2, the resultant equivalent radius of curvature "Rd" may be given as $Rd = (Dd^2 + Zd^2)/(2Zd)$. Even where the radius of curvature stays at the same value, influence upon the flatness becomes different depending on screen sizes. Due to this, as representation methodology with the flatness of panel face normalized, one method is available for representing the flatness in a way which follows:

for the outer surface, define Ro = 42.5V + 45.0 mm,
for the inner surface, define Ri = 40.0V + 40.0 mm,

then, use it as a reference (1R) to specify what times greater than this. Here, "V" is a value of a diagonal effective diameter as represented in inches. It has been well known that if the outer radius of curvature of the outer face is at 10R then the resultant plane is seen to be almost flat. If it is 36V then a radius of curvature corresponding to 10R is 15,750 millimeters (mm). Additionally, if it is 20R then the plane is seen to be almost perfectly flat. A radius of curvature corresponding to this case is 31,500 mm. The outer panel face stated above substantially corresponds to this.

[0007] Although the outer panel surface is flat, it is required to form a curved plane for a shadow mask 5. As the

curved plane of such shadow mask is typically set at certain values close or approximative to the panel's curved inner plane, it remains necessary to let the inner panel face have its curvature that is extremely larger than that of the outer face. In this case, brightness deviation can take place between the center and peripheral portions of the panel due to the fact that a glass plate thickness Tc at the panel center is different from a glass plate thickness Td at the periphery in the tube axis direction of a Brawn tube (such difference between the values Td and Tc is called a wedge amount Wd). To avoid this, clear materials have been traditionally employed as the glass material required. However, because such clear glass materials are inherently less in contrast, it has been inevitable to perform surface coating processings for reduction of the optical transmittance thereof. The present invention is the one for specifically setting a ratio of the wedge amount (Wd) to the screen center glass thickness (Tc) i.e. Wd/Tc so that this ratio is less than or equal to 0.8 thereby enabling use of either tint materials or dark tint materials. Even in this case also, it will be recommendable that the absolute value of such wedge amount be less than or equal to 12 mm; preferably, 10 mm or less. With the 36V panel of the illustrative embodiment, the central glass thickness 19-mm wedge is 9.21 mm. Use of tint or dark tint materials advantageously avoid the need to perform additional surface processings for increasing the contrast. Table 3 presented below demonstrates a relation of glass materials versus optical transmittance values in case the glass plate thickness is set at 10.16 mm.

Table 3.

Relation of glass material vs. transmittance.	
Material	Transmittance (%)
Clear	86.0
Semi-clear	80.0
Tint	57.0
Dark Tint	46.0

[0008] In this case, in order to further reduce the difference between the center and periphery of the panel, let the shadow mask be variable in pitch for increase of what is called the "purity" margin at the periphery to thereby increase the resultant electron beam transmittance of the shadow mask, which in turn makes it possible to lower the center-to-periphery brightness ratio. Letting the shadow mask be variable in pitch also achieves another advantage as to capability of permitting the shadow mask to exhibit further enhanced curvature at the periphery thereof. In the embodiment of the present invention as disclosed herein, an aperture pitch of the shadow mask in a horizontal direction of the center portion (Pc) is designed to measure 0.9 mm whereas an aperture pitch of the shadow mask at the diagonal effective diameter edge portion (Pd) is set at 1.26 mm, which results in achievement of a mask pitch grading of 40%. With such value settings, it becomes possible to improve by 15% the mask transmittance at the periphery of an electron beam. While an increase in shadow mask pitch results in a decrease in resolution of on-screen images at the periphery, it is possible to suppress any increase in shadow mask pitch down to approximately 30% ($Pd/Pc \geqq 1.3$) by letting the value of Wd/Tc be set at 0.7 or below. Note that letting Wd/Tc be 0.5 or less makes it possible to suppress further reduce such shadow mask pitch increase in shadow mask pitch down to approximately 20% ($Pd/Pc \geqq 1.2$).

[0009] In the event that the wedge is made smaller, it becomes difficult to permit the curvature of inner panel face to stay extremely large with respect to the outer panel face. One example is that in the case of the panel in accordance with the embodiment of this invention, the equivalent radius of curvature in diagonal directions measures 36,510 mm on the outer surface whereas the same is 8,480 mm on the inner face. It is difficult to manufacture the intended shadow mask of the press-machining scheme while causing it to have the same radius of curvature as that on the inner panel face. As discussed previously, letting the shadow mask be variable in pitch must result in an increase in shadow mask curvature this is advantageous but not sufficient. In this embodiment, as shown in Fig. 3, a distance between the shadow mask and the inner panel face namely, "q" size is enlarged by effectively reducing an "S" size at the periphery of a display screen. As a result of this, it becomes possible to allow the shadow mask to have a larger curvature.

[0010] Unfortunately an increase in q-size would result in increases in influence of geomagnetism upon electron beams concerned, which leads to degradation of the color purity of on-screen images. This geomagnetic influence or interference is serious particularly at the periphery of a display screen. The instant invention is for eliminating or at least greatly suppressing any possible decreases in purity at the screen periphery by enlarging in advance the S-size at the cathodes of an electron gun with the q-size made smaller as a whole. According to the teachings of this invention, the S-size on a cathode plane is set at 6.0 mm or greater. In the illustrative embodiment it is 6.3 mm. With such value setup, it becomes possible to reduce the q-size by about 15% as compared to the case of S = 5.5 mm as has been typically used in the prior art. An upper limit of the S-size increment is determinable by the outer diameter of a neck 2 also. In this embodiment the outer diameter of the neck 2 is 29.1 mm. Additionally, letting S = 6.6 mm enables partial

use of prior known electron gum technologies.

[0011] One principal feature of the present invention is that the use of two electromagnetic quadrupole lenses permits simultaneous accomplishment of both a technique for decreasing the effective S-size at the screen periphery and a ring-shaped magnet (PCM) for use in adjusting the purity and convergence. Practically, make use of two separate electromagnetic quadrupole lenses as disposed in the tube axis direction to reducing an S-size at the periphery of a display screen. Although currently available purity/convergence adjustment methodology may include a variety of kinds of approaches including, but not limited to, a method for assembling or mounting a magnet within the neck of a Brawn tube, and a method having the steps of forming a coil outside of the neck and then performing adjustment by using a magnetic field due to a flow of current, a standard approach in most cases is to employ a method of adjustment with bipolar and quadrupole plus hexapole ring-like magnets installed outside of the neck. One example of this approach has been disclosed in United States Patent No. 4,570,140, which is hereby incorporated by reference. While this method as taught by USP '140 offers technical storage, it calls for a certain space on the neck. In the case of using a couple of electromagnetic quadrupole lenses, it is required that the first one of such electromagnetic quadrupole lenses be formed on or above the neck of a Brawn tube, which results in that a need to reserve the required above-the-neck space poses problems.

[0012] A first layout method of the present invention is shown in Fig. 4. In this drawing, reference numerals 121, 122, 123, and 124 designate respective pairs of ring magnets, which are of dipole, quadrupole, hexapole, and quadrupole. Presence of two quadrupole pairs is for correction of the so-called arc-shaped misconvergence. One pair (122 or 124) of these quadrupole pairs may be placed at a location in close proximity to a CY coil 102. Numeral 101 denotes the core of a deflection yoke, and 102 is a CY coil for frame correction. A second electromagnetic quadrupole coil 21 is wound around the deflection yoke core 101. 50 is a shield cup at the distal end of an electron gun, and 51 is a pole piece as assembled within the shield cup. This pole piece is made of magnetic materials. Reference numeral 20 is a first electromagnetic quadrupole coil that is mounted between the PCM magnet and CY coil and installed at a substantially corresponding portion of the pole piece. Especially in the case of large-screen color Brown tubes for use in television (TV) sets, a velocity modulation coil (VM coil) 103 is employable for enhancement of the on-screen contrast. In the illustrative embodiment this VM coil 103 is installed between the first electromagnetic quadrupole coil 20 and the neck 2. On the contrary thereto, the VM coil 103 may alternatively be installed between the electromagnetic quadrupole coil 20 and the neck 2.

[0013] Locating the first electromagnetic quadrupole 20 at a specified position far from the main lens of an electron gun makes it possible to suppress or lighten the influence of this coil with respect to focus. In addition, use of the pole piece enables successful utilization of magnetic fluxes of the electromagnetic quadrupole. Whereas the deflection yoke's vertical deflection coil has its length in the tube axis direction that is substantially the same as that of the core, its horizontal deflection coil is elongated so that it is present up to the front side and rear side of the coil. Fig. 5 shows a state in which the pole piece has been assembled to the shield cup used. Arrows depicted in Fig. 5 are used to indicate exemplary directions of magnetic fluxes due to the electromagnetic quadrupole. The magnetic fluxes are generated from the electromagnetic quadrupole coil 20 and pass through the pole piece 92 to act on electron beams on the both sides. Although in Fig. 5 four electromagnetic quadrupole coils 20 are recited for purposes of explanation of the principle, such four coils may be a continuous one.

[0014] A second layout method of the present invention is shown in Fig. 6. In this case the ring magnets (PCMs) 121-124 are designed to have an increased inner diameter while disposing the first electromagnetic quadrupole coil between the neck glass and ring magnet. This electromagnetic quadrupole coil may be made of any materials as long as these are capable of well controlling the electron beam spacing "S" as a function of deflection angles involved. In this case it will not always be required to provide the pole piece within the shield cup. In this embodiment the VM coil 103 was installed between the electromagnetic quadrupole 20 and the CY coil 102. Note here that although in both the first layout example and the second example of this invention are arranged so that the deflection yoke is set forth in such a way as to be integral with its associative PCM and the first electromagnetic quadrupole coil, they may be arranged by separate or discrete members when the need arises to do so.

[0015] Fig. 7 is an example of an electron gun used in the present invention. Fig. 7 is a diagram showing a longitudinal cross-sectional view of the electron gun. In Fig. 7, numeral 40 designates a set of three cathodes as disposed in a direction at right angles to the surface of drawing paper at an interval of 6.3 mm between adjacent ones of them. Numeral 41 denotes a control electrode G1, and 42 is an acceleration electrode G2. Electrodes 43, 44, 45 are provided to constitute a pre-focus-stage lens structure. A static focusing voltage Vfs is applied to the electrodes 43 and 45 while the same as the acceleration electrode is applied to the electrode 44. These three electrodes form a so-called UPF lens. Although any one of the electrodes 46, 47, 48 is a focusing electrode, they are divided into separate parts in order to form a lens having dynamic characteristics.

A dynamic focusing voltage that increases in potential with an increase in deflection angle is applied to the electrode 46 and electrode 48 whereas a static focus voltage is applied to the electrode 47. An opening or hole that is formed in an electrode 451 is wider than it is tall; a hole formed in an electrode 461 is taller than it is wide. Whereby the intended

static electromagnetic quadrupole is formed along with a dynamic voltage. 462 is a horizontal plate-like electrode; 472 is a vertical plate electrode. These two electrodes make up another electromagnetic quadrupole. A hole that is taller than it is wide is formed in each of electrodes 471, 481, whereby the lens intensity varies with a change in dynamic voltage applied thereto and, simultaneously, a lens is formed which functions to let an electron beam be greater in longitudinal dimension. An anode voltage that is the maximum voltage among those voltages concerned is applied to an anode electrode 49, whereby a main lens is formed between it and the electrode 48. This main lens is such that its lens intensity tends to decrease with an increase in dynamic voltage. 482 is a focus plate electrode which is installed within the focus electrode 48 and which has a longitudinally longer hole or aperture. 491 is a plate-like electrode which is installed within the anode electrode and which has a longitudinally longer hole or aperture. Fig. 8 is a detailed diagram of the main lens unit. This is one of those electron guns of the large lens diameter type. Although the internal electrodes 482, 491 shown herein are designed so that each has three longitudinally longer holes, such may be modified if necessary to have only one electron-beam passing hole at the center thereof with specified portions on the opposite sides being cut away. In cases where a phosphor plane is made flat, focusing can be degraded especially at its peripheral portions; fortunately, such focusing degradation at the periphery may be suppressed or lightened by use of dynamic focusing techniques. In addition, the use of the large-lens type electron gun as set forth in this embodiment makes it possible to reduce or minimize any possible focus degradation in the event that a high current flows therein.

Claims

1. An inline type color picture tube including an evacuated envelop housing having a panel (1) with a phosphor film (4) formed on an inner surface thereof and a neck portion (2) having therein an electron gun (9) plus a funnel portion (3) connecting the panel and the neck together as well as a shadow mask (5) press formed to oppose the inner surface of said panel along with a defection yoke (10) being attached to a portion at or near said neck and a connecting portion of said funnel portion and having a horizontal deflection coil and a vertical deflection coil plus a core, said neck having its outer periphery with a ring-like magnet (12) being attached thereto for adjustment of purity and convergence, characterized in that

   an equivalent radius of curvature, Rd, as measured in millimeters (mm) in a diagonal direction of an outer surface of said panel is determined to satisfy a relation of

$$Rd\ (mm) \geq 10R\ (mm)$$

   where R is given as

$$R = 42.4V + 45.0$$

   where V is a value of a diagonal effective diameter in units of inches;
   said panel is made of a tint glass material;
   when letting a central glass thickness of said panel be represented by "Tc", and a glass thickness thereof in a tube direction at a diagonal effective diameter edge portion be indicated by "Td" and Wd=Td-Tc, when $Wd/Tc \leq 0.8$ is obtained;
   said electron gun includes an array of cathodes (43-48) aligned in an inline direction at a distance, Sk, between adjacent ones of said cathodes, said distance Sk is greater than or equal to 6.0 mm; and
   a first coil (20) is attached to outside of said neck for forming an electromagnetic quadrupole for use in letting an electron beam spacing change as a function of a deflection angle whereas a second coil is attached to said deflection yoke for forming an electromagnetic quadrupole as used to change the electron beam spacing as a function of the deflection angle.

2. The inline type color picture tube according to claim 1, characterized in that the values Wd and Tc are determined to satisfy $Wd/Tc \leq 0.7$.

3. The inline type color picture tube according to claim 1, characterized in that the values Wd and Tc are determined to satisfy $Wd/Tc \leq 0.5$.

4. An inline type color picture tube including an evacuated envelop housing having a panel (1) with a phosphor film

(4) formed on an inner surface thereof and a neck portion (2) having therein an electron gun (9) plus a funnel portion (3) connecting the panel and the neck together as well as a shadow mask (5) press formed to oppose the inner surface of said panel along with a defection yoke (10) being attached to a portion at or near said neck and a connecting portion of said funnel portion and having a horizontal deflection coil and a vertical deflection coil plus a core, said neck having its outer periphery with a ring-like magnet (12) being attached thereto for adjustment of purity and convergence, characterized in that

an equivalent radius of curvature, Rd, as measured in millimeters (mm) in a diagonal direction of an outer surface of said panel is determined to satisfy a relation of

$$Rd\ (mm) \geq 10R\ (mm)$$

where R is given as

$$R = 42.4V + 45.0$$

where V is a value of a diagonal effective diameter in units of inches;
said panel is made of a tint glass material;
when letting a central glass thickness of said panel be represented by "Tc", a glass thickness thereof in a tube direction at a diagonal effective diameter edge portion be indicated by "Td" and Td - Tc = Wd, then Wd is 12 mm or less;
said electron gun includes an array of cathodes aligned in an inline direction at a distance, Sk, between adjacent ones of said cathodes, said distance Sk is greater than or equal to 6.0 mm; and
a first coil (20) is attached to outside of said neck for forming an electromagnetic quadrupole for use in letting an electron beam spacing change as a function of a deflection angle whereas a second coil is attached to said deflection yoke for forming an electromagnetic quadrupole as used to change the electron beam spacing as a function of the deflection angle.

5. The inline type color picture tube according to claim 4, characterized in that said shadow mask has an aperture pitch in a horizontal direction and that when the aperture pitch is Pc at the center and is Pd at the diagonal effective diameter edge portions, a ratio Pd/Pc is greater than or equal to 1.3.

6. The inline type color picture tube according to claim 4, characterized in that the value Wd is less than or equal to 10 mm.

7. An inline type color picture tube including an evacuated envelop housing having a panel (1) with a phosphor film (4) formed on an inner surface thereof and a neck portion (2) having therein an electron gun (9) plus a funnel portion (3) connecting the panel and the neck together as well as a shadow mask (5) press formed to oppose the inner surface of said panel along with a defection yoke (10) being attached to a portion at or near said neck and a connecting portion of said funnel portion and having a horizontal deflection coil and a vertical deflection coil plus a core, said neck having its outer periphery with a ring-like magnet (12) being attached thereto for adjustment of purity and convergence, characterized in that

an equivalent radius of curvature, Rd, as measured in millimeters (mm) in a diagonal direction of an outer surface of said panel is determined to satisfy a relation of

$$Rd\ (mm) \geq 10R\ (mm)$$

where R is given as

$$R = 42.4V + 45.0$$

where V is a value of a diagonal effective diameter in units of inches;
said panel is made of a dark tint glass material;

when letting a central glass thickness of said panel be represented by "Tc" and a glass thickness thereof in a tube direction at a diagonal effective diameter edge portion be indicated by "Td", then $Wd/Tc \leq 0.7$ is obtained where $Wd=Td-Tc$;
said electron gun includes an array of cathodes aligned in an inline direction at a distance, Sk, between adjacent ones of said cathodes, said distance Sk is greater than or equal to 6.0 mm; and
a first coil (20) is attached to outside of said neck for forming an electromagnetic quadrupole for use in letting an electron beam spacing change as a function of a deflection angle whereas a second coil is attached to said deflection yoke for forming an electromagnetic quadrupole as used to change the electron beam spacing as a function of the deflection angle.

8. The inline type color picture tube according to claim 7, characterized in that the values Wd and Tc are determined to satisfy $Wd/Tc \leq 0.5$.

9. An inline type color picture tube including an evacuated envelop housing having a panel (1) with a phosphor film (4) formed on an inner surface thereof and a neck portion (2) having therein an electron gun (9) plus a funnel portion (3) connecting the panel and the neck together as well as a shadow mask (5) press formed to oppose the inner surface of said panel along with a defection yoke (10) being attached to a portion at or near said neck and a connecting portion of said funnel portion and having a horizontal deflection coil and a vertical deflection coil plus a core, said neck having its outer periphery with a ring-like magnet (12) being attached thereto for adjustment of purity and convergence, characterized in that

an equivalent radius of curvature, Rd, as measured in millimeters (mm) in a diagonal direction of an outer surface of said panel is determined to satisfy a relation of

$$Rd(mm) \geq 10R\ (mm)$$

where R is given as

$$R = 42.4V + 45.0$$

where V is a value of a diagonal effective diameter in units of inches;
said panel is made of a dark tint glass material;
when letting a central glass thickness of said panel be represented by "Tc" and a glass thickness thereof in a tube direction at a diagonal effective diameter edge portion be indicated by "Td", then Wd is less than or equal to 10 mm where $Wd=Td-Tc$;
said electron gun includes an array of cathodes (43-48) aligned in an inline direction at a distance, Sk, between adjacent ones of said cathodes, said distance Sk is greater that or equal to 6.0 mm; and
a first coil (20) is attached to outside of said neck for forming an electromagnetic quadrupole for use in letting an electron beam spacing change as a function of a deflection angle whereas a second coil is attached to said deflection yoke for forming an electromagnetic quadrupole as used to change the electron beam spacing as a function of the deflection angle.

10. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said shadow mask has an aperture pitch in a horizontal direction and that when the aperture pitch is Pc at the center and is Pd at the diagonal effective diameter edge portions, a ratio Pd/Pc is greater than or equal to 1.2.

11. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said cathode distance Sk is substantially equal to 6.3 mm.

12. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said cathode distance Sk is substantially equal to 6.6 mm.

13. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said first coil is formed between said ring-like magnet and said neck.

14. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said first coil is formed

between said ring-like magnet and the core of said deflection yoke.

15. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that a CY coil for coma correction is formed on a cathode side of said electron gun of the horizontal deflection coil of said deflection yoke and that said first coil is formed between said CY coil and said ring-like magnet.

16. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said first coil is formed in close proximity to the phosphorus place rather than the main lens of said electron gun.

17. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said electron gun has a pole piece used to form the electromagnetic quadrupole and that said first coil is formed adjacent to said pole piece.

18. The inline type color picture tube according to claim 1, 4, 7 or 9, characterized in that said pole piece it attached to a shield cup of said electron gun.

FIG. 1

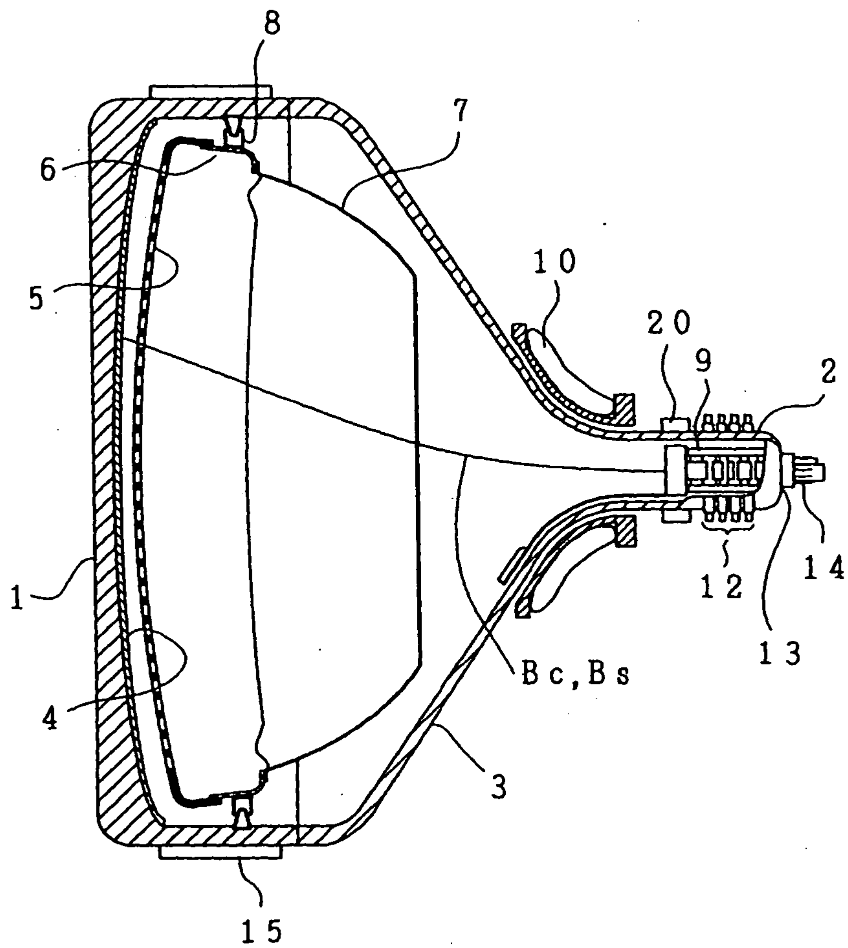
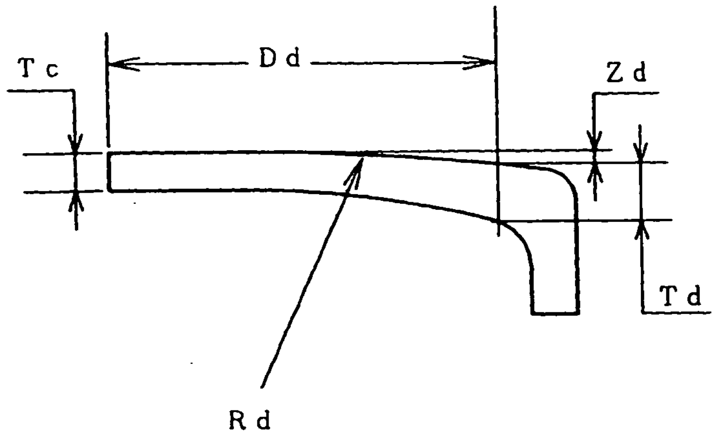


FIG. 2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Dd
Zd
Td
Rd

FIG. 3

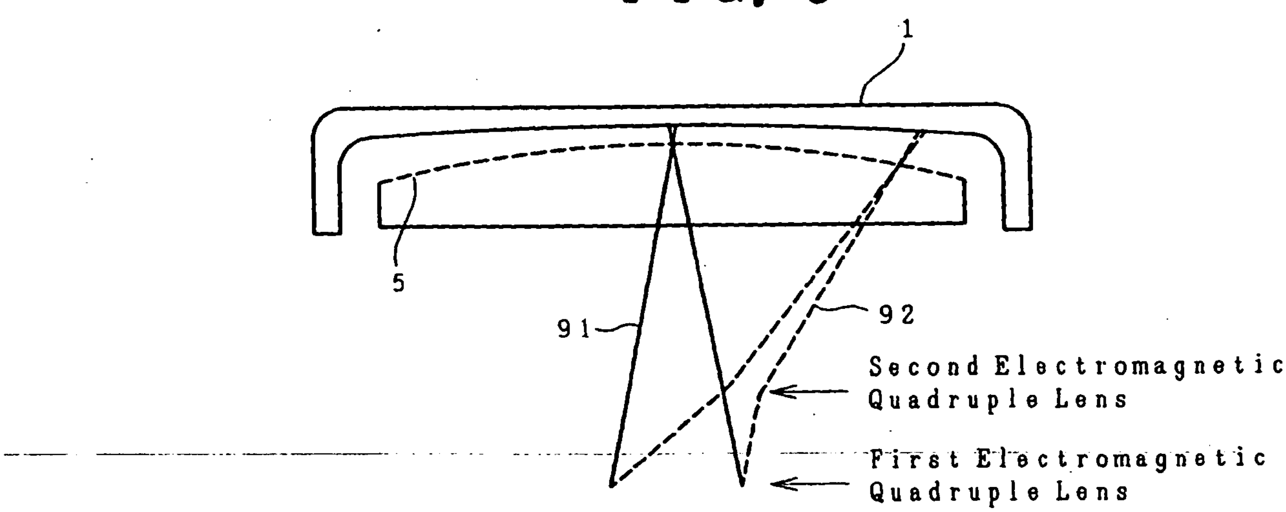

1
5
91
92
Second Electromagnetic Quadruple Lens
First Electromagnetic Quadruple Lens

FIG. 4

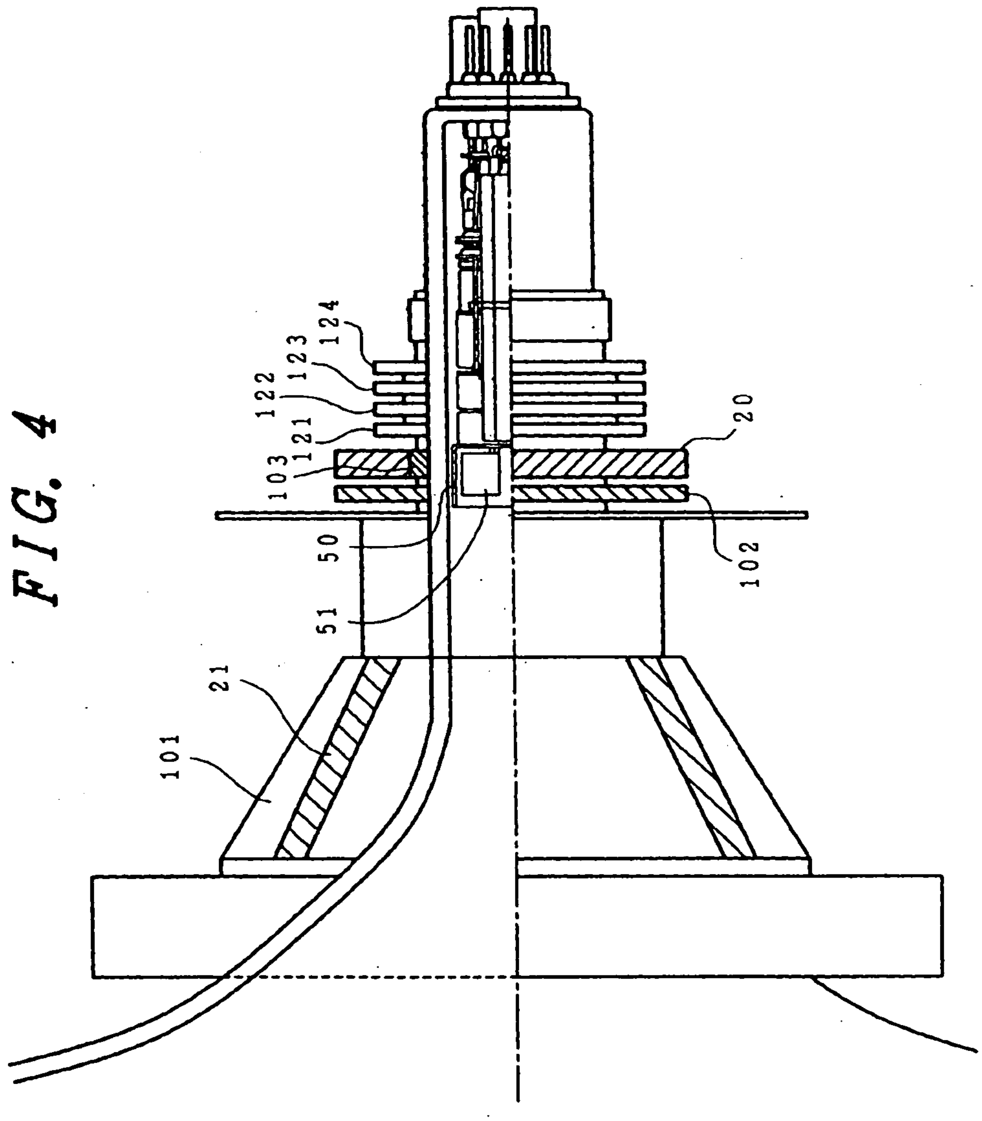


FIG. 5

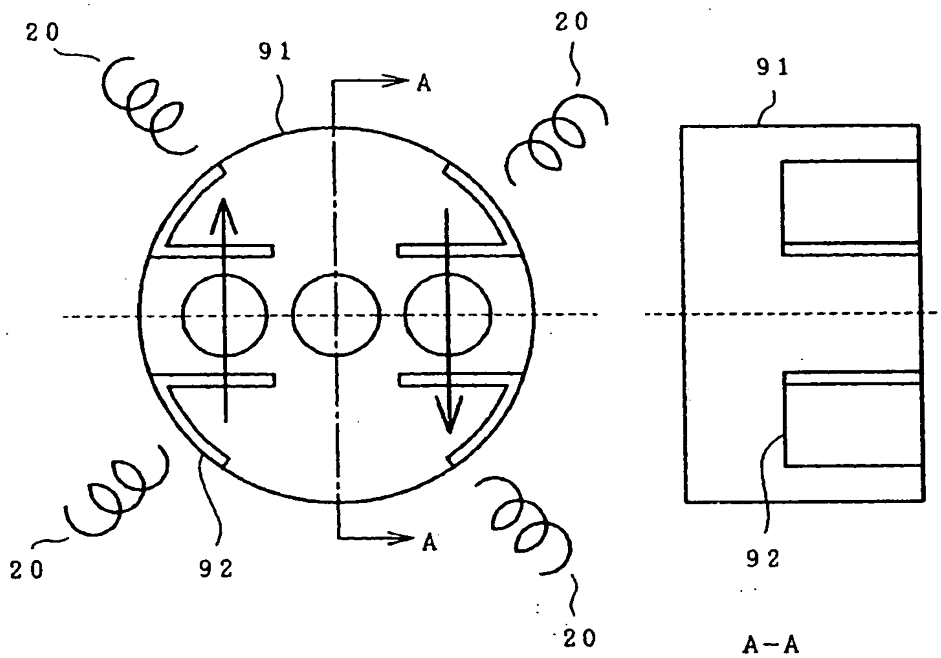
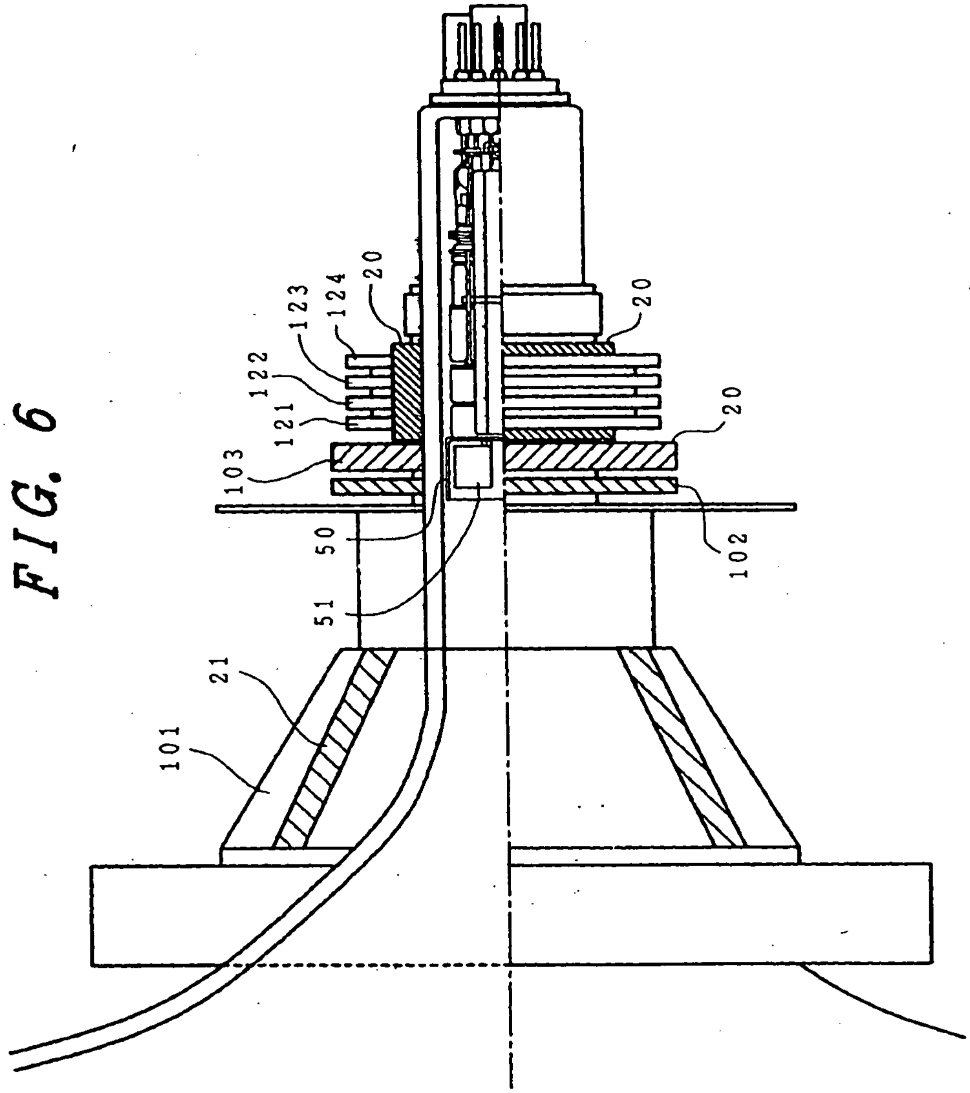
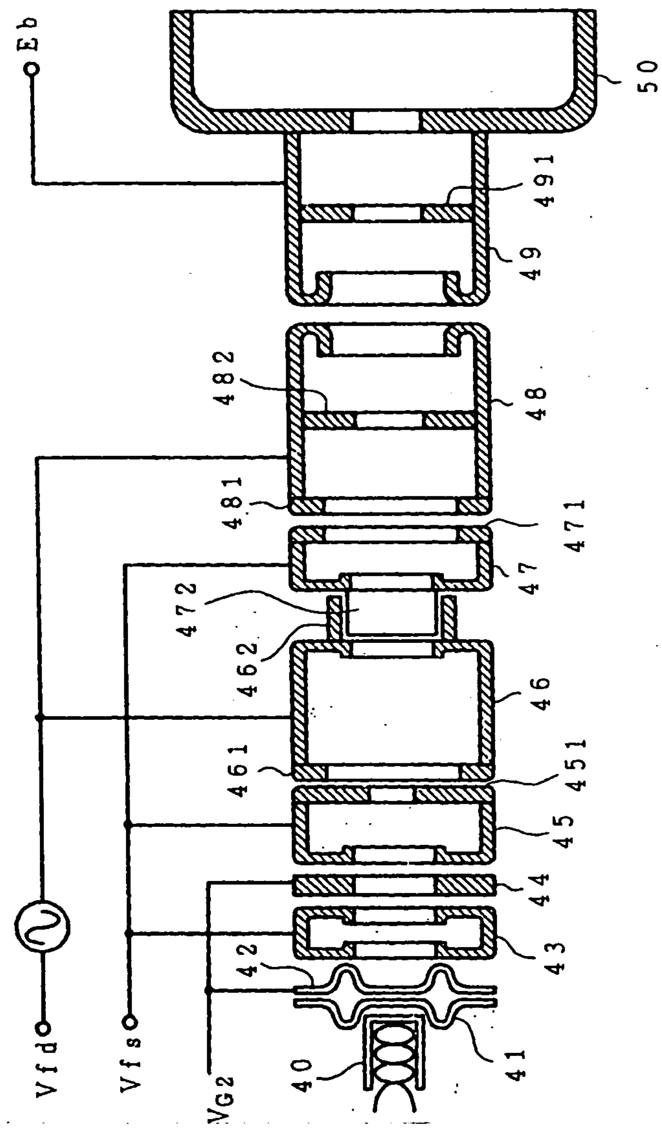


FIG. 6




Eb
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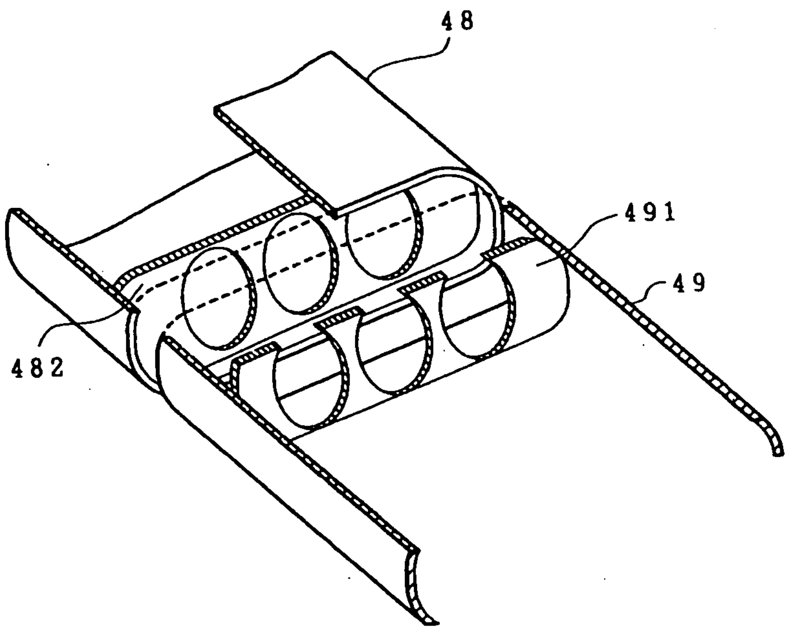
40
Vfd
Vfs
VG2

FIG. 7

FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 0146

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MUNICH	31 May 2000	Centmayer, F

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EUROPEAN SEARCH REPORT

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